DEVELOPING A MOTORCYCLE AND SCOOTER SAFETY COMPENDIUM FOR THE ASIA-PACIFIC ECONOMIC COOPERATION (APEC)

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ABSTRACT

Motorcycle and scooter crashes are significant contributors to road trauma in many low, medium and high income countries. The APEC Transportation Working Group has commissioned CARRS-Q to develop a compendium of best practice measures that can be used to reduce crashes, post-crash trauma and associated socio-economic costs.

The compendium will be informed by findings from a literature review and an expert survey. The literature review examined motorcycle and scooter safety usage and fatalities along with socio-cultural factors which might influence safety in each economy.

A discussion is provided regarding the processes involved in the expert survey and how this might be integrated with the findings from the literature review. The implications for developing the compendium are discussed as is the next step of a workshop to further disseminate findings. This will enable the identification of important motorcycle safety issues in APEC economies and implications for implementation of countermeasures.

INTRODUCTION

Internationally, motorcyclists and scooter riders are among the most vulnerable road users. Riding a powered two-wheeler (PTW) is much more likely to result in injury than car travel, and the resulting injuries are likely to be more severe for motorcyclists than for vehicle occupants. Fatality and serious injury rates are reported to be 30 to 35 times greater for motorcyclists than car drivers, with brain and orthopaedic injuries prevalent (Johnston, Brooks & Savage, 2008; National Center for Statistics and Analysis Research and Development, 2008).

There is no clear estimate available of the total numbers of motorcyclists killed and injured throughout the world. However, motorcyclists generally comprise a higher proportion of fatalities in low and medium income countries (LMICs) than in high income countries (HICs). The large number of deaths in LMICs is likely to reflect both the greater use of motorcycles and the high risk of PTW riders being involved in crashes involving fatalities (WHO, 2006). The pattern of riding PTWs and fatality rates represent only part of the picture of differences between countries and therefore potential differences in effective countermeasures. Socio-cultural factors may be different across countries, for example the personal and social significance of riding, the quality of protective gear and quality of the motorcycle, and the potential impact and medical treatment following a crash. Patterns of use, injuries and associated socio-cultural factors associated with riding have important implications for the development and implementation of effective countermeasures.

The Asia Pacific Economic Cooperation (APEC) "is the premier forum for facilitating economic growth, cooperation, trade and investment in the Asia-Pacific region" (see http://www.apec.org/). Malaysia is one of the 21 member economies of APEC (see list in Table 1) which includes low, middle and high income countries. The APEC Transportation Working Group (TPT-WG) aims to enhance the safety and security of APEC transportation systems and thus encourage economic development in the Asia-Pacific region (see http://www.apec-tptwg.org.cn/). The Road Safety Sub-group of the TPT-WG has commissioned the Centre for Accident Research and Road Safety-Queensland (CARRS-Q) to develop a compendium of best practice measures to improve motorcycle and scooter safety that can be used to reduce crashes, post-crash trauma and associated socio-economic costs. The intended audience for the compendium is road safety policy makers, practitioners and professionals in APEC economies; and when the compendium is translated into other languages, also other non-APEC nations.

Stage 1 of the project comprised the development and administration of a survey to identify the most important motorcycle safety issues in the APEC economies and any current barriers to addressing these issues. The results of the survey were not available at the time of preparation of this paper but will be presented at the conference. Some results from the literature review that comprised part of Stage 2 are presented in this paper.

METHOD

Methodology of the literature review

The academic literature and government reports were reviewed in relation to measures that address motorcycle and scooter safety including information on practical and cost-effective safety measures that can be implemented in APEC economies. Relevant research findings were identified by searching electronic publications databases, by checking proceedings of recent conferences and by Internet searches (including websites of organizations that may have sponsored recent research).

Methodology of the survey

Experts from each APEC economy were asked to complete a survey. Initially the expert was identified by the economy's representative on the TPT-WG and it was requested that they seek further information from other local experts where appropriate. The survey included items about the most important motorcycle safety issues in APEC economies and any current barriers to addressing these issues, measures that have been implemented to improve motorcycle safety to date, the factors that made implementation possible, barriers that had to be overcome and how this was done, and factors that prevented the implementation being more effective. In addition, there were questions about the role of motorcycling in transport; alternative transport options and their feasibility; types of motorcycles ridden; and usual number of occupants per motorcycle. Potential case studies and visual material for the compendium were also requested. In consideration of the likely unavailability of official statistics to answer some items, respondents were encouraged to provide an indication of the likely value and to rate the likely precision of their answer, providing comments where necessary.

Table 1 - Percentage of all vehicles and percentage of road user deaths for PTWs and estimated national helmet wearing rates for each APEC member economy

Member Economy	Population (2007 estimation)[*]	PTWs as % of all vehicles	PTWs as % of road user deaths[*]	Helmet Wearing Rates (%)
Australia	20,743,179	4[**]	14.8	...[**]
Brunei Darussalam	390,056	4[**]	11.1	98[**]
Canada	32,876,047	3[***]	7.3	?
Chile	16,634,760	2[***]	2.6	100[***]
People's Republic of China	1,338,612,968[Δ]	?	28.1[**] (all of China)	16 (Guangxi province only)[**]
Hong Kong, China	7,055,071[Δ]	?	?	?
Indonesia	231,626,978	73	61.0	93[†]
Japan	127,966,709	14[**]	17.6	...[*]
Republic of Korea	48,223,853	10[**]	20.7	85[*]
Malaysia	26,571,879	47[**]	58.0	90% drivers 70% passengers[**]
Mexico	106,534,880	3[***]	5.5	-[***]
New Zealand	4,178,525	3[**]	9.0	-[**]
Papua New Guinea	6,331,011	2[**]	0.0	...[**]
Peru	27,902,760	0	0	-[***]
The Republic of the Philippines	87,960,117	48[**]	34	34[**]
The Russian Federation	142,498,532	8[****]	2.1	?
Singapore	4,436,281	17[**]	47.7	56[**]
Chinese Taipei	22,974,347[Δ]	68[Ω]		
Thailand	63,883,662	63	69.7	27[†]
United States of America	305,826,246	2.8[≠]	11.3[≠]	63[^]
Viet Nam	87,375,196	95[**]	59	85[**]

[*] WHO, 2009a, except for People's Republic of China, Hong Kong, China, Chinese Taipei, Republic of the Philippines and Viet Nam

[Δ] CIA – The World Factbook, 2009 [**] WHO, 2009b, [***] WHO, 2009c, [****] WHO, 2009d, [†] WHO 2009e

[Ω] 14,365,000 registered motorcycles and 6,727,000 registered cars, data from Transportation and Communication, 2009

[≠] FHWA 2008 [^] National Center for Statistics and Analysis, 2009

FINDINGS

Pattern of PTW use and fatalities

The literature review first examined the pattern of PTW use and fatalities. It has been estimated that there are 313 million motorcycles in the world of which 77% are in Asia, 5% in Latin America and 2% in North America (Rogers, 2008). While much of the motorcycle safety research emanates from Europe and North America, these two continents comprise only 16% of the world motorcycle fleet. Within Asia, China has the most motorcycles (about 100 million), followed by India (about 40 million), Indonesia (about 30 million) and Thailand, Viet Nam and Japan (about 15 million) (Rogers, 2008). Asian countries are also the largest producers of motorcycles. In 2006, the top five motorcycle producing countries were China, India, Indonesia, Japan and Chinese Taipei. Thailand, Viet Nam and Malaysia were also among the top 10 motorcycle producing countries (Rogers, 2008).

Internationally, the number of motorcycles is increasing, with the largest increases in Asia. Rogers (2008) presented growth figures for motorcycles in Asia, based on the Honda World Motorcycle Facts & Figures 2007 and SIAM estimates. From 1995 to 2006, the motorcycle fleet increased from 20 million to about 100 million in China. The motorcycle fleet approximately doubled in India and tripled in Indonesia. In contrast, motorcycle production has decreased in Japan and Chinese Taipei since 1996.

Increases in the numbers of motorcycles have also been occurring in Australia and the United States. The number of motorcycles registered increased by 57% from 2004 to 2009 (Australian Bureau of Statistics, 2009), the strongest growth of any vehicle type in Australia. The number of motorcyclist fatalities in the US has increased from a low of 2,116 in 1997 to 4,810 in 2006 (National Center for Statistics and Analysis Research and Development, 2008). Across Australia, the number of motorcyclist (rider and pillion) fatalities has risen from 175 in 1997 to 238 in 2006 (Johnston et al, 2008).

Table 1 summarises the distribution of PTW use and fatalities in APEC economies. Among the APEC economies, PTWs made up more than half of road fatalities in Thailand, Indonesia, Malaysia and Viet Nam, but less than 10% in Peru, Papua New Guinea, the Russian Federation, Chile, Canada and New Zealand.

Socio-cultural factors related to motorcycle use

The differences between countries in the representation of motorcycles form only part of the picture. There are variations in uses of motorcycles, the personal and social significance of motorcycling as an activity, which segments of the population are more likely to use motorcycles, and the consequent patterns of injuries and fatalities.

Strifelt (2008) stresses the differences among riders, in terms of why they ride, whether or not they belong to organised rider groups and their level of safety awareness. Strifelt (2008) also points out that motorcycling provides an affordable means of transporting goods in Asia. In large cities of some HICs, motorcycles are commonly used for commuting, while in the US and Canada, use for touring is more common than commuting.

Rogers (2008) noted that enjoyment was an important factor in many HICs (such as the APEC economies of United States, Canada, Australia and New Zealand) but that employment/entrepreneurship was important in many LMICs (such as the APEC economies of Indonesia, Mexico, the Philippines and Thailand). Ease of use is an important factor in locations where significant traffic congestion exists. Economy of purchase and use is also an important factor in many LMICs.

The types of PTWs and their main purposes of use also differ markedly between HICs and LMICs. In HICs, many PTWs are large engine capacity motorcycles which are used for leisure. In LMICs, PTWs are largely used as a means of mobility and most motorcycles are low and medium engine capacity motorcycles and scooters (Rogers, 2008). Perversely, larger motorcycles in HICs tend to be used by single riders, while the smaller motorcycles and scooters in LMICs frequently carry passengers and are used with a variety of attachments for carriage, delivery, vending and passenger transport.

Factors contributing to crash occurrence and severity

Most studies of factors contributing to the occurrence and severity of motorcycle and scooter crashes have been conducted in HICs (ACEM, 2000; Haworth et al., 1997; Hurt, Ouellet & Thom, 1981) with a small number of exceptions (e.g. Thailand motorcycle crash study, Kasantikul, 2002). In HICs, the factors that have been identified as contributing to crash occurrence can be summarised as (Haworth, Mulvihill & Clark, 2007):

- Inexperience or lack of recent experience;
- Driver failures to see motorcycles;
- Instability and braking difficulties;
- Road surface and environmental hazards; and
- Risk taking (speeding, drink riding, illegal manoeuvres).

In HICs, the factors contributing to injury severity can be summarised as:

- Vulnerability to injury (all riders and especially older riders);
- Hitting a fixed object in SV crashes (Shankar & Mannering, 1996); and
- Risk taking (drink riding, not wearing a helmet, speeding).

The relative importance of these factors may be different in LMICs. The Thailand motorcycle study found higher rates of drink riding crashes in Thailand than in the United States (Kasantikul & Ouellet, 2005), but alcohol led to similar types of crashes in the two locations. Conversely, it found that driver failure to see motorcycles was much less common in Thailand than in the US. Thai riders (including non-drinkers) were more likely to violate red traffic signals and ride the wrong way in traffic lanes than American riders. The authors speculate that the latter behaviours are responses to travel more quickly in congested traffic in Thailand.

Measures to improve motorcycle safety

Haworth, Mulvihill and Clark (2007) structured motorcycle safety measures according to the Haddon matrix (see Table 2). The initiatives were grouped respectively according to whether they are road user, vehicle based, or environmental initiatives. Then within each initiative, a set of proposed measures were presented and grouped according to whether they are a crash prevention measure or a measure designed to reduce injury severity in the event of a crash. This classification was found to be useful and workable. The suitability of this classification (or a modification thereof) will be examined in relation to the compendium.

Most of the greatest gains in motorcycle and scooter safety in LMICs have resulted from programs to increase helmet wearing by legislation, promotion and enforcement. The World Health Organization reports that in Thailand, in 1992, when helmet use was not mandatory, 90% of deaths resulting from traffic injuries were among motorcycle users, almost all due to head injuries (http://www.who.int/mediacentre/news/releases/2006/pr44/en/). Legislation passed in the province of Khon Kaen to make helmet use mandatory, supported by

enforcement and publicity programmes, led to a 40% reduction in head injuries among motorcyclists and a 24% drop in motorcyclist deaths within the two years.

Table 2 - Using the Haddon matrix to classify measures to improve motorcycle and scooter safety (from Haworth, Mulvihill & Clark, 2007).

	PREVENT CRASH	**REDUCE INJURY SEVERITY**	**IMPROVE TREATMENT**
ROAD USER			
Rider	Licensing Training Enforcement	Helmets Protective clothing	Safer removal of helmets
Other road user	Increased awareness of PTWs Enforcement		
VEHICLE			
Motorcycle or scooter	Improvements to braking Improved maintenance Conspicuity Choosing safer motorcycles Improved field of view	Knee protection Fairings Airbags	Automatic collision notification
Other vehicle	Improved field of view	More motorcycle-friendly design	
ENVIRONMENT	Better road surfaces Intersection improvements Road space allocation Better delineation Blackspot treatments	Improved roadside safety (incl barriers)	Improved emergency response (access and trauma management)

DISCUSSION AND CONCLUSIONS

The diversity of importance of PTWs across the APEC economies is striking. The percentage of all registered vehicles that are PTWs ranges from 0% to 95% and the percentage of PTW riders and passengers in road user deaths varies from 0% to 70%. On an absolute scale, China has the most PTWs in the world, followed by Indonesia, and then Thailand. Overall, the APEC economies represent a large amount of the world's motorcycle use and therefore the compendium of best practice has the potential to make a major difference.

There are a large number of differences among APEC economies in terms of the proportion of vehicles that are PTWs, the purposes for which they are used and the characteristics of riders and passengers. These differences are likely to affect the contribution of factors such as risk taking, rider impairment, and violation of right of way by other drivers to crash occurrence and severity. PTW use factors and contributory factors must be considered, along with cultural and governmental factors, when selecting appropriate safety measures. Yet the fundamental vulnerability of PTW riders and passengers is common to all economies and provides a clear rationale to focus on improving the degree of protection provided to riders and passengers by better and more widespread use of effective helmets and protective clothing.

The results of the literature review and the survey will identify safety issues and measures for inclusion in the compendium. Given that not all safety measures are likely to be effective and that the evidence of effectiveness varies across measures, standards for inclusion will need to be developed. These standards will take into consideration both the size of the likely benefit of the measure and the strength of evidence supporting the measure. While measures that are likely to have a large benefit and for which there is clear evidence to support their effectiveness (e.g. helmets) should clearly be included, it is likely that most measures will not fall into this category. In a literature review of motorcycle safety measures prepared by Haworth, Mulvihill and Clark (2007) it was noted that many motorcycle safety measures had not been evaluated. While there have been a number of large evaluations of rider training, most of these studies have identified flaws. Thus, it may be necessary to categorise safety measures into “proven effective”, “potentially effective” and “unlikely to be effective”, with an understanding that a measure might fall into different categories in different cultural settings.

Economies also differ with respect to factors which influence both their current motorcycle safety problems and the likely success of particular safety measures, e.g. the effectiveness of enforcement, the budget and governance capacity of government agencies (King, 2007). There is limited information available from the literature which will be supplemented by information from the survey. Case studies will be used to illustrate how safety measures can be chosen to fit the broader context of motorcycle safety in a specific country.

An attempt will be made to select case studies that cover a variety of safety measures in a variety of economies that have the potential for similar implementation in other economies or which may illustrate a general principle of implementation (e.g. the need for a measure to integrate well with local beliefs). The presentation of the case studies will explicitly acknowledge the influence of particular economic, institutional, social and cultural factors on the success of these measures in these particular settings and will point out the need to take these factors into account in deciding whether the same measure would work in another setting.

The degree to which any of these measures will be suitable for introduction or adaptation will depend on the economic, institutional, social and cultural context, and the compendium will provide advice on how to assess these factors and how they will influence the choice of safety measure. The intended audience for the compendium will be road safety policy makers, practitioners and professionals in APEC economies; and when the compendium is translated into other languages, also other non-APEC nations. The nature of the intended audience must also be considered when selecting the most appropriate structure.

To ensure that economies have access to the information a workshop to further disseminate findings is proposed. Thus as a next step for road safety capacity building (Stage 3), it has been proposed that a workshop be held after the completion of the project to present the safety measures in the compendium and to facilitate their implementation.

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